Money and prices in the Maghreb countries: cointegration and causality analyses

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Money and Prices in the Maghreb Countries: Cointegration and Causality Analyses

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Abstract

Inflation has been the major global economic problem for most economies throughout the world over the last three decades. It affects individuals, businesses and governments. Many competing hypotheses have been advanced in the literature to explain its causes and give the appropriate remedial policies. One of these hypotheses is central to the quantity theory of money. According to this hypothesis, inflation results solely from a maintained expansion of the money stock at rates in excess of increases in the amount of money demanded in the economy.

The paper examines the money-price relationship in the Three Maghreb countries (namely Algeria, Morocco and Tunisia) using Granger causality test. The results do not tend to support the quantity theorist's view that money and prices have a long-run relationship, i.e., they do not tend to drift apart in the long run. However, as suggested by Granger (1986) money and prices could still cointegrate if other variables, which may have influenced prices, were included in the cointegration regressions. Second, the finding of a unidirectional causation from money to prices in the case of Morocco and Tunisia is in line with the monetarist's view that money precedes and causes inflation. In fact, this finding supports Darrat's (1986) finding that money causes inflation in Morocco and Tunisia. Thus the monetary authorities in these two countries can consider control of the money supply (M1) or (M2) to influence and control inflation. As suggested by monetarists, this can be best achieved by maintaining a steady rate of growth of the money supply, roughly corresponding to the long-run growth of the real output. Our results also show the apparent absence of causality between money and prices in the case of Algeria which is not easy to explain. A possible explanation may be that the data for the Consumer Price Index (CPI) are not reliable. This may be true given that the prices, which are reported by the authorities, are always lower than those actually paid in the market place.

Key words: *Co integration – bootstrap- money – prices- Granger causality – inflation – Maghreb.*

1. Introduction

Over the past two decades, policy makers have become more aware of the social and economic costs of inflation and more concerned with a stable price level as a goal of economic policy. Price stability is desirable because a rise in price level (inflation) creates uncertainty in the economy, and that may hamper economic growth. For example, the information conveyed by the prices of goods and services is harder to interpret when the overall level of prices is changing, which complicates decision making for consumers, businesses and government. Not only do public opinion surveys indicate that the public is very hostile to inflation, but also a growing body of evidence suggests that inflation leads to lower economic growth (Fisher, 1993).The most extreme example of unstable prices is hyperinflation, such as Argentina and Brazil experienced until recently. Many economists attribute the slower growth that these countries have experienced to their problems with hyperinflation.

Inflation also makes it hard to plan for the future. For example, it is more difficult to decide how much funds should be put aside to provide for a child's college education in an inflationary environment. Many competing hypotheses have been advanced in the literature to explain its causes and give the appropriate remedial policies. One of these hypotheses is central to the quantity theory of money. According to this hypothesis, inflation results solely from a maintained expansion of the money stock at rates in excess of increases in the amount of money demanded in the economy.

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This paper attempts to estimate money-price relationship in Algeria, Morocco and Tunisia. In the recent days, empirical analysis on money-price relationship has received greater attention, as there is a move to assign the single objective to the central bank. Among likely candidates of monetary policy objective, price stability is the single most important objective. Assignment of price stability as the single objective of monetary policy hinges on the empirical strength of money-price relationship. If empirical results show a strong and robust relationship between money supply and prices, then the central bank can opt for price stability as its single objective.

The empirical issue of money-price relationship is important for Maghreb countries for two reasons. First, there is a move to introduce new central banking reforms (mainly for Algeria), and it is important to set the objective of monetary authorities. If empirical analysis reveals a strong association between money supply and prices, then price stability can be taken as the most important candidate for monetary policy objectives. Second, Maghreb countries have accelerated economic reforms since the early 1990s with outward orientation of the economy; and hence it is important to ascertain the structural shift of money-price relationship during the study period.

This paper is articulated as follows: After this brief introduction, the second section deals with the theoretical aspect of money-price relationship. The third section enlists Some previous studies on money price causality, and the fourth gives a short description of monetary policy in Algeria, Morocco and Tunisia,. Similarly, the fifth section highlights estimations techniques and methodology. The empirical results are discussed in the sixth section. Finally, the seventh section draws conclusions and policy recommendations of the study.

2. The Economics of Money and Prices

This section briefly discusses the theoretical evolution of money and price relationship and begins with the analysis of the classical quantity theory of money. It also discusses the Keynesian' view of this theory, and the Phillips curve analysis of money and price relationship. The reformulation made by the monetarists to the quantity theory is also discussed. The section also deals with the issue of rational expectation hypothesis. Finally, the section ends with a brief discussion on policy implications for the quantity theorists' view of money-price causality.

2-1 The Quantity Theory of Money

The idea that inflation, defined as a sustained increase in the general price level, is strongly influenced by monetary growth is central to the quantity theory of money.

The quantity theory of money postulates a direct and proportional relationship between money supply and price level. The traditional quantity theory of money is encapsulated in the Fisher's equation of exchange given below.

$$MV = PY \qquad (1)$$

Where, M is money supply, V is the income velocity of money, P is the price level and Y is the income level. The quantity theory of money assumes full employment in the economy.

Velocity also remains stable at least in the short-run. Hence, both Y and V do not change. Among the variables in equation (1), only two variables M and P vary.

Equation (1) can be recast as:

$$P = MV/Y \qquad (2)$$

As V and Y are assumed to be constant, we can rewrite equation (2) as

$$P = f(M) \qquad (3)$$

The classical view can also be expressed by the Cambridge Cash Balance Equation.

$$M = KPY \qquad (4)$$

Where K is the desired cash ratio, and with the assumptions that (K) and (Y) are constant, equation (4) leads to the same above conclusion.

Classical quantity theorists maintain that the causal relation between money and prices is from the former to the latter. They define two mechanisms or channels through which money influences prices – namely the direct mechanism an the indirect mechanism-. The direct mechanism refers to the process by which the impact of the monetary change is channeled to the price level via prior effect on the demand for goods.

The key link in this process is the relationship between actual and desired real balances. Classical economists hold that money is only held for transaction purposes and that people want to hold a constant quantity of real cash balance at the full economy's capacity level of real output. The money supply is assumed to be exogenous, i.e., determined by the monetary authorities. At the existing price level, the given money supply determines an actual real money balances. The variations in the rate of spending are seen as the means by which the actual real balances are adjusted to the level that people desire to hold. Thus, for example, starting from a position of monetary equilibrium, an increase in the money supply initially will raise real cash balances above the pre-existing desired leve l. Cash-holders will be left with more money than they want to hold, thereby prompting them to get rid of the excess via spending for goods. Given that the economy is operating at full capacity, however, the increased spending will exert upward pressure on prices. Spending, prices and nominal income will continue to rise until cash holders are just satisfied to hold the nominal money in existence. Equilibrium is restored when prices rise sufficiently to bring real cash balances back to the desired level. In brief, the direct mechanism relies on the disequilibrium between actual and desired real balances to induce the spending that ultimately causes prices to change in proportion to the monetary expansion.

By contrast, the indirect mechanism refers to the process by which a monetary change influences spending and prices indirectly by via a prior effect on the interest rate. In this process a monetary injection first causes the rate of interest to fall below the profit rate (expected yield) on new capital projects. Then this disparity between profit and loan rates encourages firms to invest in new capital assets and in consumer durable goods too. With output unresponsive to this increased demand, the rise in the money supply forces the price level upwards. This rise in prices leads to a reduction in the supply of loans in real terms causing interest rate to rise back into equality with the profit rate. The proportionality result between money and prices in ensured in the long-run.

2-2 Keynesian Views on Money and Price Relationship

The classical view of the role of money in determining the price level dominated macroeconomic theory and policy up to the 1930s. After that, however, it en countered heavy criticism from Keynesians. The Keynesian attack on the classical quantity theory can be summarised in the following points:

First, Keynes argued that the quantity theory assumes an automatic tendency of the economy to operate at full capacity. He maintains that only if production and employment are fixed at full capacity would monetary- induced changes in spending manifest themselves on prices .If the economy was operating at less than full employment changes in spending would affect output and employment rather than prices.

Second, Keynes criticised the quantity theory as expressed in (1) and (4) in that it is a tautological identity rather than an empirically refutable hypothesis, and in that it erroneously treated the circulation velocity of money as near-constant. He contented that the velocity is extremely unstable and that it might passively adapt to independent changes in the other variables. For example, in equation (1), the impact of any change in M might be absorbed by an offsetting change in V and therefore would not be transmitted to P.

Third, Keynes rejected the direct transmission mechanism. He maintained that the substitutability between money and physical assets such as houses, cars, and other consumer goods is very low. Thus a large change in the (implicit) rate of interest on real assets is needed to encourage shifts between them and the money. Further, Keynes doubted the simplicity and potency of an indirect mechanism. He gave three reasons for that. First he maintained that monetary injection might be absorbed immediately into idle balances without lowering interest rates sufficiently to stimulate investment spending.

This conclusion is based on Keynes' theory of an absolute preference for liquidity at low rate level, i.e., the case of the so- called liquidity trap. This case refers to the situation where the interest rate is very low that everyone is expecting it to increase. At this level of interest rate the demand for money with respect to the interest rate becomes infinitely elastic, with financial assets becoming perfect substitutes. Any increase in the money supply requires only a minute change in the rate of interest to encourage investors to take up the extra cash. The second reason concerns the interest elasticity of investment. Keynes argued that even if monetary injections were successful in lowering market interest rates, those injections still would not stimulate economic activity if investment spending was unresponsive to changes in interest rate. The third reason is related to investment- income relationship. According to Keynes "whilst an increase in the volume of investment may be expected ceteris paribus to increase employment this may not happen if the propensity to consume is falling off".

In contrast to the direct and indirect mechanisms, Keynes proposed an alternative mechanism –namely the income multiplier. He argued that there is a multiplier relationship between autonomous expenditure (non-income- induced expenditures, e.g., government outlays for public works projects) and total income. This emphasis on the determinants of spending rather than the stock of money has the implication that fiscal policy would have a more powerful impact on income and employment than would monetary policy. According to Keynesians the chief reliance should be placed on government budgetary (tax and expend iture) policy rather than on monetary policy to stabilise the economy. In addition to the above listed Keynes' criticisms, the post-Keynesians economists added others. First, is the view that inflation is predominantly a cost-push phenomenon associated wit h union bargaining strength, monopoly power and other factor costs.

Second, is the view that the money supply has only a passive role in the transmission mechanism. The money supply increases only to accommodate the increase in prices due to raise in costs. This is in sharp contrast to the view of the classical quantity theorists which stresses that the money stock changes precede and cause changes in prices, i.e., money has an active role in the transmission mechanism. Third is the view that expansionary monetary policy could be used to peg interest rates at lower levels. An alternative version of the same argument is that monetary policy could help peg the unemployment rate at permanently low levels. This view is encapsulated in the Phillips curve. The Phillips curve envisages that money has effects both on price level and output (unemployment). The Phillips curve posits a trade-off between money wage inflation and unemployment. Keynesians argue that there is a choice for policy makers to make. Increasing money supply helps to increase inflation but also to reduce unemployment. Hence, inflation is the inverse function of unemployment. It must be noted that there is departure in the Keynesian theory of money from the quantity theory of money. Keynesians do not assume full employment. With the increase in money supply, employment opportunities, output and prices increase. The Keynesians, with their limited role for monetary policy action in the determination of macroeconomic variables, held the orthodox position until the mid 1960s. Since then it has come under severe attacks from modern quantity theorists.

2-3 Reformulation of Quantity Theory of Money

The major response to the Keynesian criticism of the classical quantity theory came from Friedman 1956 who restated the quantity theory in terms of the demand for money function. Monetarists maintain that the quantity theory is the theory of the demand for money, it is not a theory of nominal income or the price level. Moreover they state that the velocity of mone y is a stable function of a limited number of variables and has a low interest elasticity. This implies that an increase in the money supply will not be absorbed into idle balances. With this new interpolation of the quantity theory, modern quantity theorists were able to rebut many of the Keynesian criticisms.

To illustrate the Friedman analysis, we assume that initially unemployment and output are at their natural levels and that prices are constant. An increase in the money supply leads to an increase in expenditure and prices. Friedman argues that employers will recognise the increase in the price of their own product before they perceive the increase in the general price level. Thus they will increase their production and be prepared to pay higher wages to attract the additional labour they will require. Workers, as well, will be slow to adjust their perception of the general level of prices, and in meantime will see the increase in money wages as an increase in real wages. Therefore, they increase the supply of labour. Thus in the short-run an increase in the money supply, via portfolio adjustment and increased expenditure, leads to an increase in prices, money wages, output and employment.

But all of these outcomes, according to Friedman, are due to una nticipated inflation. They arise only because employers and employees are slow to recognise that prices in general are rising. According to Friedman, once workers realise that the increase in their money wages is matched by increases in the general level of prices they know they know that their real wages have not risen. As a result the supply of labour contracts back to its original level, and unemployment and output return to their natural rates. Friedman's analysis, therefore, distinguishes, as the classical quantity theory does, between short-run and long-run effects of an increase in the money supply. Only in the short- run, where there exists unanticipated inflation, will there be any effect on output and employment as well as on prices. In the long-run, however, when unanticipated inflation is eliminated, output and employment return to their natural rates and only prices rise.

2-4 Rational Expectation Hypothesis (REH)

The REH postulates that Phillips curve does not exit even in the short run.

It suggests that expectations of price changes always lag behind actual price changes. According to this school economic agents would not be behaving rationally if their perceptions of price changes were always 'catching up on' actual price changes. The main conclusion of the rational expectations school is that systematic changes in the money stock are fully anticipated and hence cannot influence real variables, they influence prices only Non systematic changes in the money stock, however cannot be expected hence they influence real variables in the short- run In the long-run, as in the expectations augmented Phillips curve, these real effects disappear and only prices rise.

Fisher (1977), and Phelps and Taylor (1985) criticised the rational expectations school in that it implicitly assumes that wages and prices are fully flexible. They contend that the existence of long-term contracts such as long-term labour contracts prevent some prices and wages from rising fully with a raise in the expected price level. The models the constructed assume that expectations are rational however do not assume complete prices and wages flexibility. Instead, they assume that wages and prices are sticky. Their basic conclusion is that unanticipated monetary changes have a larger effect on real variables than anticipated monetary changes. This conclusion differs from the conclusion of the rational expectations school in that monetary changes do affect real variables in the short-run even if they are fully anticipated.

2-5 Policy Implications for the Quantity Theorists' View of Money-Price Causality

From the policy makers point of view two important aspects are of particular interest. The first aspect is the time it takes for changes in the rate of money growth to work through to the rate of inflation which is long and variable. The second aspect is the market short-run impact of changes in money growth on real variables such as income and employment. These two aspects have important implications for monetary policy (Bezzaouya, 1991).

First owing to the slow response of inflation to a monetary change, it necessary takes a long-time for anti-inflationary monetary policy to work. Quick monetary remedies for inflation do not exist. Moreover, since the first effect of a change in the growth rate is on real variables than prices, monetary restraint would almost surely entail a recession or at least a marked retardation in the expansion of the economy. In sum, a temporary but protracted period of high employment and sluggish growth would nave to be tolerated if monetary policy were to be successful in permanently lowering the rate of inflation.

Second, due to the difference in timing of the response of output and prices to a monetary change, anti- inflationary policy may appear impotent or, even worse, counter-productive and perverse. Because inflationary movements tend to subside slowly, prices may continue to rise long after output and employment have turned down. Such situation is known as stagflation.

Third, the pattern of response- output first, prices only much later may create the dangerous illusion that expansive policy in the upswing can achieve permanent can achieve permanent gains in output and employment at the cost of very little additional inflation. This view may have unfortunate consequences. For quantity theorists reasoning teaches that stimulative policy can peg output and employment above their natural or equilibrium only by continuously accelerating the rate of inflation. According to quantity theorists the appropriate way for the monetary authority to achieve price stability and avoid economic disturbances is that discretionary (activist) policy should be abandoned in favour of a rigid rule whereby the money supply grows at steady figure roughly corresponding to the long-term growth of real output.

3. Some Previous work concerning Money-Price Causality

The direction of causality between money and prices has been tested for many countries over various periods of time. The results have yielded conflicting evidence. Arturo Brillembourg and Mohsin S.Khan (1979) tested the money-price causality for the U.S.A over the period 1870-1975. They used the methodology developed by Sims (1972). The test consists of regressing money (prices) on past, present and future values of prices (money). If money causes prices then the coefficients of all future values of money should be approximately equal to zero in the regression. The results showed unidirectional causation from money to prices. The authors concluded that the results confirm the basic lo ng-run monetarist proposition of Friedman and Schwartz (1963) that money causes prices. Jones (1989) used the Granger causality test to test the causality between money and prices for the U.S.A over the period 1950Q1 to 1986Q2. The test implies that after extracting all the information from the own past values of a variable, and if the addition of another variable as a regressor would further reduce prediction error variance, then the latter variable is causal.

In other words, a variable is causal if it explains the residuals of another variable, which cannot be explained by the history of that explained variable. Jones used two measures of money, M1 and M2, and two measures of prices, the consumer price index (CPI) and the wholesale price index (WPI). In general, the results showed bi-directional causation between money (M1,M2) and prices (CPI,WPI).

No empirical examination of the causality between money and prices has been performed for Algeria. However, for Morocco and Tunisia a study was held by Darrat (1986). Darrat used the procedure proposed by Sargent (1976) to test the direction of causation between money and prices for Morocco, Tunisia and Libya over the period 1960Q1 and 1980Q2. M1 and CPI were used in this test. The results show a unidirectional causation running from money to prices without feedback for all the three countries concerned. Darrat concluded that the results support the monetarist view that money causes inflation.

Adel Boughrara (2002) provides provide a description of the central characteristics of the Tunisian monetary policy. More interestingly, Boughrara found that the reverse null hypotheses that prices do not Granger-cause money supply in the long-run as well as in the short-run are rejected (all the p-values are less than 5%,). The above results of money supply- prices suggest that, on the whole, money supply growth has no significant impact upon inflation; as a consequence, a such relationship cannot be considered as reliable for monetary targeting strategy. We can see that Bougrara;s results contradicts those of Darrat (1986).

From another context of causality, (Boulila and Trabelsi, 2003) examined empirically the causality issue between financial development and economic growth in a bivariate VAR structure for a sample covering some MENA countries and different periods ranging from 1960 to 2002.With Johanson cointegration analysis, they found less support to the hypothesis that finance is a leading sector in growth processes. In other words, the financial sector does not seem to affect positively the long-run growth. The empirical results display also strong evidence in favor of causality running from growth of GDP per capita to financial development for two countries. For countries where financial and growth proxies are not cointegrated, they carried out Granger causality tests with first differenced VARs to tackle the issue of causality in the short run. The evidence gave little support to the hypothesis that finance is a leading sector in the growth process. Moreover, for many countries they found evidence of bi- directional causality and causality from the real to the financial sector.

On the other hand, (Darrat and Haj , 2002) found that short-run causality effects from financial development to growth volatility are genera lly weak or non-existent in the MENA countries. These findings reveal some difficulty for policy-makers in the MENA region in their pursuit to achieve economic stability. The above is just illustrative examples using causality and cointegration tests in MENA countries. Nonetheless, empirical studies are still lacking using new econometric techniques in the region.

4. Short description of the monetary policy in Algeria, Morocco and Tunisia

The financial sector reform strategies in the Maghreb countries varied in speed and depth, but had similar objectives and instruments. The main objectives of the reforms is to reduce government intervention and strengthen the role of market forces in the allocation of financial resources, improve the capacity of financial institutions to mobilize domestic savings, enhance the effectiveness of monetary policy instruments, promote competition among banks, and strengthen their financial soundness (Jbaili et al, 1997). Reforms initially centered on the banking system and the monetary policy, and in Morocco and Tunisia were followed by a reform of bond markets and the stock exchange. In all three countries, banking laws were adapted to grant greater independence to the Central Bank and strengthen its capacity for banking supervision.

4-1 Algeria

The conduct of monetary policy in Algeria is complex. Algeria began the process of opening its economy in the early 1990s, by reforming, inter alia, the financial sector and the conduct of monetary policy, with the introduction of indirect instruments of monetary control. However, monetary policy in Algeria is still conducted in a difficult context because it is affected by the economy's strong dependence on hydrocarbon exports (35 percent of GDP, 95percent total exports, and 70 percent of total fiscal revenues on average) and the volatility of energy prices on international markets (IMF, 2003). In practice, foreign currency receipts generated by hydrocarbon exports are repatriated and surrendered by Sonatrach (State owned petroleum company) to the bank of Algeria, which in turn credits Sonatrach's account held at its commercial bank in dinar. Most export receipts (65 percent) are then transferred o the Treasury in the form of staggered tax payments.

The remaining 35 percent share of Sonatrach actually contributes to an increase in the money supply, when the government does not spend its share. The largest part of the potential money creation resulting from an increase in hydrocarbon revenues actually arises from expansionary fiscal policies supported by higher revenues. The banking system liquidity is subject to large swings as a function of international oil prices because of their impact on Sonatrach's deposits in commercial banks. Therefore, the primary concern of the central bank, when implanting monetary policy, has been to control the liquidity of banks through interventions on the interbank market.

One of the main objectives of the Central Bank of Algeria is achieving price stability. but in environment of volatile hydrocarbon revenues which lead to disequilibrium in the money market , what are the instruments that the Bank of Algeria should use in Order to achieve monetary policy intermediate objective, and how can the monetary authorities maintain the price stability?

4-2 Morocco

Over the recent years Morocco has achieved stable macroeconomic conditions with low inflation and a strong external position. Money market conditions in 2003 were characterised by abundant liquidity in the banking system, resulting primarily from the sizable balance of payment surplus due to workers' remittances and financial flows relating to the privatisation of the tobacco monopoly (IMF, 2004). Bank Al-Maghrib (BAM) mopped up excess liquidity using deposit auctions and raising reserve requirements, which limited downward pressure on money market interest rates. BAM is expecting that broad money would grow by 8.3 percent. Inflation is projected at 2 percent.

Morocco has opted for a new flexible exchange rate regime. However a new monetary framework with well-defined intermediate and operational targets would need to be put in place to ensure that inflation under control after exiting the peg. Under a flexible exchange regime, monetary developments would impact inflation since the latter would no longer be pinned down by the exchange rate peg. Thus, in IMF staff's view (IMF, 2004), there is a need to adapt the framework for monetary policy to the new circumstances, while deepening the understanding of the relation between money and prices.

4-3 Tunisia

Tunisia has pursued financial sector reforms since the late 1980s. These reforms involved the introduction of indirect monetary policy instruments. The primary objectives of monetary policy in legislation include preserving the value of the currency and to support the economic policies of the government. The main purpose of the monetary policy is to preserve the (internal and external) value of the currency. Nevertheless, the institutional responsibility for foreign exchange policy is not clearly defined and publicly disclosed. Also it should be noted that the CBT (Central Bank of Tunisia) is entrusted with several missions in its charter, in particular supporting the government's economic policy, in addition to its general mission of defending the value of the currency and ensuring its stability. While the law does not explicitly state that price stability takes precedence over the responsibility to support the economic objectives of the government, the monetary authorities see price stability as the primary objective of the CBT.

Boughrara (2002) pointed out that the monetary policy strategy of the CBT assigned a prominent role to money growth. In particular, the deviation of current M2 growth from a reference value is interpreted as an indicator of the risk to price stability. Currently, the CBT develops a notion of the appropriate growth of the money supply and the amount of refinancing according the following three steps procedure. First, the growth of M2 is set at 2% below the projected growth of nominal GDP. Second, under the assumption of a roughly constant multiplier, the amount of base money supply consistent with the target growth of M2 is calculated. Third, taking into account projected net international reserves and the credit requirement of the agricultural sector, the CBT determines the quantity of liquidity to be distributed through the refinancing facilities.

On a weekly basis, these amounts are fine-tuned taking into account the perceived financing needs of the commercial banks. While the CBT monitors a number of other indicators, such as the level of net international reserves and the monthly inflation rate to assess the appropriateness of its monetary policy, monetary aggregate M2 appears to be the Tunisian Central Bank's leading indicator of monetary policy. The stability-oriented monetary policy strategy is the framework adopted by the Central Bank of Tunisia since 1987 to achieve price stability. The selection of a strategy is of great importance for the CBT, because it represents not only a structure that allows the institution to filter the information but also a guide for external communication with the public.

5- Estimations Techniques and Methodology

5-1 limitations of the study

Serious data limitations in monetary statistics, national accounts, and price indices limit the analysis. As for as Algeria is concerned, there are no published data on GDP at constant prices. The basket adopted in the calculation of the consumer price index (CPI), which is used to measure inflation, has not been updated since 1989. For Tunisia, however, Non availability of quarterly data on prices before the third quarter of 1975 is the main reason for the choice and the limitation of the sample size. Furthermore, the non availability of quarterly data on GDP has also been another limitation of the study. This constrained to include GDP as a scale variable in the study. The Data for morocco, are all computed annually and this is another limitation of the sample size.

5-2 Definitions of Variables

Two measures of money supply are used for Maghreb countries. They are narrow money (M1) and broad money (M2). M1 includes currency held by non-bank public and demand deposit held at the monetary sector. M2 consists of M1 and time deposits held at commercial banks. Both the measures of money supply are used to see their influences on prices.

As far as prices are concerned, we will be using the Consumer Price Index (CPI) for each country. The Gross Domestic Product (GDP) is also used.

5-3 Database

The data covers the period from 1975 to 2003or the case of Algeria and Morocco. As mentioned above all the variables are taken on annual basis. However in the case of Algeria the post reform period (i.e., 1990-2003) using quarterly data. For Tunisia, Quarterly data are used for the study and the sample period is 1987-2003. The data on money and prices are obtained from various sources. Various issues of International Financial Statistics (IFS), Quarterly Economic Bulletin of NRB, World Development Indicators of the World Bank (2001) and the international financial statistics of the IMF (2003), statistics of the Central Bank of Tunisia for Tunisian data and the central bank of Algeria for Algerian data.

5-4 stages of analysis

Before proceeding to test the set of variables for cointegration, it is sensible to establish the properties of the individual time series. Much of the theory of Cointegration has been developed for the case where all the series are I(1). So , we must determine the order of integration of each exchange rate series. This is the basis of the first stage of the analysis. Then , we go further and test for cointegration, which is the second stage. After that and due to the sample size problem we will be using the bootstrap. Bootstrap methods are resampling techniques for assessing uncertainty. They are useful when inference is to be based on a complex procedure for which theoretical results are unavailable or not useful for the sample size met in practise, where a standard model is suspect but it is unclear to replace it, or when a 'quick or dirty' answer is required (Davison and Kuonen, 2003). There are many advantages for using these new methods. For instance, (Hestrberg, et al,2003) pointed out some of these advantages:

- *Fewer assumptions*. For example, resampling methods do not require that distributions be Normal or that sample size is large.
- *Greater accuracy*. Permutation tests, and some bootstrap methods, are more accurate in practise than classical methods.
- *Generality.* Resampling methods are remarkably similar to a wide range of statistics and do not require new formula for every statistic.
- *Promote understanding*. Bootstarp procedures build intuition by providing concrete analogies of theoretical concepts.

Testing for Unit Roots

To test if the series in question have unit roots, we use a test based on the work of Fuller (1976) and Dickey & Fuller (1979,1981). So, to check the validity of the first hypothesis, which is **St ~ I(1),** we estimate the following equation by OLS.

$$\Delta S_t = \alpha_0 + \alpha_1 S_{t-1} + U_t \qquad (5)$$

The test which has been used by Dickey-Fuller(1981)is the ratio of α_1 to its calculated standard error that is obtained from the regression. The null hypothesis is that :

H0 : **St ~ I(1) ,**

This is rejected if α_1 is negative and significantly different from zero. The Dickey- Fuller test does not have a t-distribution but tables of significance have been provided to test this hypothesis (Dickey-Fuller 1979).

The other test is similar to the DF test in (5) but modified to:

$$\Delta S_t = \alpha_0 + \alpha_1 S_{t-1} \sum_{t=1}^{p} b\Delta S_{t-1} + U_t \qquad (6)$$

Where, ***p*** is selected large enough to ensure that their residual U_t is an empirical white noise. This test is called the Augmented Dickey-Fuller (ADF) test. And again it is the ratio of α_1 to its calculated standard error in equation (6). If the error term is white noise without addition of any auxiliary lagged variables, the DF is the appropriate test, whereas if it is needed to add lags in (5) to achieve the residual whiteness then the ADF test is more appropriate.

Nachrane, D.M., et. Al (1988), argued that the application of DF and ADF tests is complicated by the fact that when lags are present in the relationship , equation (5) is inappropriate , and when lags are absent equation (6) is over-parameterised .Another difficulty is that critical values given by Engel and granger (1987) are available only for ***p=1***, and ***p=4***. For instance , Taylor (1988) tested the 1(1) hypothesis for five currencies during the period June 1973 to December 1985 . He found that only in two of the series , we need to add lags in the regression to achieve the whiteness of the residuals.

Testing for cointegration

If we cannot reject the null hypothesis that both the spot and forward rates are I(1) , we can go on to test for cointegration , and see if Ut (the residual from the cointegration regression) appear to be I(0) . Because of the different properties of the tests propose by Engel and Granger (1987), we will be using all of them .They propose seven test statistics that are calculated by Ordinary Least Squares . We concentrate , however on the DF and ADF tests.

1 - *Dickey-Fuller (DF) test.*

This is based on the test for unit roots as initially formulated by Fuller (1976), and then extended by Dickey and Fuller (1979.1981) . Let Ut denotes the residuals from the cointegration regression , Ut -1 their first differences, and consider

$$\Delta U_t = \phi U_{t-1} + \varepsilon_t \qquad (7)$$

The above equation is estimated by OLS .The DF test is the t-ratio of (f).critical values for DF statistics are given in fuller (1976) .

2- *Augmented Dickey-Fuller test (ADF) .*

This test proceeds essentially as the DF test but with equation (7) modified to :

$$\Delta U_t = \phi U_{t-1} + \varepsilon_t + \sum_{t=1}^{p} b_i \Delta U_{t-1} + \varepsilon_t \qquad (8)$$

Where p is a suitably chosen lag length .Once again the ADF test is simply the t statistic of f in equation (8) .Critical values are given by Engel and Granger(1987).

6. Empirical Results

As mentioned earlier, before proceeding to test for cointegr ation, it is necessary to determine the order of integration of the series of the logarithm of the money supplies (M1, M2) and the logarithm of the price level (CPI) for each country concerned. In order to test for the unit roots in these three series, the Augmented Dickey Fuller (ADF) is used. The results of the test are presented in table (1). For Morocco and Tunisia we are unable to reject the null hypothesis that the variables M1, M2 and CPI are an I(1). For Algeria, However the I(1) hypothesis is rejected for the period 1975-2003 (i.e., when annual data was used). In fact, the series were found to be I(2). But When the hypothesis was tested for the post reform period only (i.e. 1990-2003 quarterly data), the results show that we are unable to reject the hypothesis that M1, M2 and CPI are I(1) series.

After determining that the variables are of order I(1), we now turn to examine whether they are cointegrated or not. The first step is to run a cointegration regression. In the present paper two cointegration regressions are set. In the first one, we regress the logarithm of the price level (LCPI) on the logarithm of the money supply (LM1) and an error term. In the second regression we use the logarithm of the money supply (LM2) instead of (LM1).

The two regressions are presented in table (2a) and (2b). In testing for cointegration two tests were used, namely, Cointegration Regression Durbin Watson (CRDW) and Augmented Dickey Fuller (ADF). The results show that: First, the signs of the coefficients of the logarithm of the money supply (LM1, LM2) are in line with economic theory, i.e., money growth has a positive impact on the price level. Second, The Cointegration Regression Durbin Watson (CRDW) gives conflicting results in the three cases. As far as the first regression is concerned, The results in table (2a) show that this test is not significantly different from zero suggesting rejection of cointegration in the case of Algeria in the first period (1975-2003) and even when using the post reform period (1990-2003), whereas when the second regression is tested, table (2b) show that the I(0) hypothesis is rejected only for the case of Algeria when the whole period is taken. Third, The ADF statistic tests show that the residuals of the regressions are found to be stationary I(0) in the case of Morocco and Tunisia. Thus the money supply (M1 or M2) and the price level (CPI) these countries are cointegrated. The ADF results for Algeria, however do not support the I(0) hypothesis when using the whole period (i.e., 1975-2003). In fact, the results show that neither M1 nor M2 are cointegrated with the price level. On the other hand, when using the post reform period for Algeria, the results show that if we could not accept the cointegration hypothesis between M1 and the price level, the relationship between M2 and CPI is found to be cointegrated.

The results for the Algerian case, mainly when the whole period is used, do not tend to support the quantity theorist's view that money and prices have a long-run relationship, i.e., they do not tend to drift apart in the long run. However, as suggested by Granger (1986) money and prices could still cointegrate if other variables, which may have influenced prices, were included in the cointegration regressions. Granger (1986) also found that money and prices do not cointegrate for the United States. He argued that other variables should be included in the investigation. As far this research is concerned we have suggested to include the Gross Domestic Product (GDP) in the case of Algeria. Indeed, table (2c) and (2d) show there are two cointegrating relationships. The first is between, M1 , GDP and CPI, whereas the second is between M2, GDP and CPI.

The Johansen procedure was also used to test the cointegration relationship between M1, M2 and the price level. Table (3a) and (3b) give similar results of those of the ADF tests. After looking for the long-run relationship of the variables, we now test for the direction of causation between money and prices for the three Maghreb countries (Algeria, Morocco and Tunisia). As mentioned earlier, monetarists maintain that the direction of causation runs from money to prices. Anti- monetarists, on the other hand, argue that the direction of causation is from prices to money. A condition for testing for the causality between two variables is that they must be stationary. In the previous section, we found that the first difference of the logarithm of the money supply (LM1,LM2) and the first difference of the logarithm of the price level (LCPI) for each country are stationary(except for Algeria when these variables was tested for the whole period 1975-2003). Thus we are using these two variables in our test. In order to test the causation between money and prices we use the Granger causality test. The test consists of the following equations:

$$\Delta CPI = \sum_{i=1}^{n} a^{*}_{i} \Delta M_{t-1} + \varepsilon_t \qquad (9)$$

$$\Delta M = \sum_{i=1}^{n} b^{*}_{i} \Delta CPI_{t-1} + \varepsilon_t \qquad (10)$$

$$\Delta CPI = \sum_{i=1}^{n} c^{*}_{i} \Delta CPI_{t-1} + \sum_{i=1}^{n} d^{*}_{i} \Delta M_{t-1} + \varepsilon_t \qquad (11)$$

$$\Delta M = \sum_{i=1}^{n} e^{*}_{i} \Delta M_{t-1} + \sum_{i=1}^{n} h^{*}_{i} \Delta CPI_{t-1} + \varepsilon_t \qquad (12)$$

Where:

ΔLCPI : is the first difference of the logarithm of the general price level.

ΔLM : is the first difference of the money supply (M1, M2).

n : is the number of lags.

As we can see, equation (9) is a restriction of equation (11), and equation (10) is a restriction of equation (12) To examine the causality between LM and LCPI, the following hypotheses are tested:

$d_i = 0, \; h_i = 0$

Where: i = 1, 2, ...n.

If neither can be rejected, then LCPI and LM are independent series. If both are rejected, then the causation runs from money to prices and from prices to money. (i.e. there is bi- directional causation between money and prices). If the former hypothesis is rejected but the latter is not, there is a unidirectional causation running from money to prices. If the latter is rejected and the former is not, their unidirectional causality running from prices to money.

In order to test for the above hypotheses we use the F test. The value of the F statistic is calculated using the following equation:

$$F = \frac{\left[\left(RSS_r - RSS_u\right)/d\right]}{\left[RSS_u/\left(N-k\right)\right]}$$

Where

RSS_r : is the residual sum of squares for the restricted equation.

RSSu : is the residual sum of squares for the unrestricted equation.

N : the number of observations used in estimating the unrestricted equation.

d : is the difference in the number of parameters between the restricted and unrestricted equation (i.e., the number of restrictions).

k : is the number of parameters in the original (i.e., unrestricted) equation.

When the value of F is calculated, the n it is compared with its corresponding critical value. The critical values of F for N = 150 and (d -k) = 12 at 10%, 5% and 1% significance level are 1.59, 1.817 and 2.305, respectively. If the calculated F is greater than its corresponding critical value we reject the null hypothesis, whereas if the calculated F is smaller then it corresponding critical value the reverse is true.

The results of Granger causality tests are presented in tables (4a) and (4b). The first table show the causality tests between the price level and M1. For Algeria, two different periods were explored, and the tests sho w no causation in any case. For both Morocco and Tunisia, the causation is from money (i.e., M1) to prices without significant feedback. This tends to support the quantity theorist's view that the causal relation between money and prices is from the former to the latter. Further, it supports Darrat's (1986) findings that money causes prices in Morocco and Tunisia. The second table (i.e. (4b)), the causality tests are made between M2 and CPI. For Algeria, the results reveal different outcomes. Where if we are still rejecting the causality hypothesis between money and prices in the first period, the results show when using the post reform data, M2 and the price level are cointegrated with significant feedback. Surprisingly, for the case of Morocco and Tunisia conflicting results are found. There is no causation between M2 and the price level in Morocco, and we could only accept this hypothesis at the 10 % confidence level for the case of Tunisia. This result support Boughrara's (2002) findings for the Tunisian case.

Due to the sample size problem and the non homogeneity of data bootstrap method was used to test the cointegration regressions as in table (2a) and table (2b). As Said earlier, bootstrap methods are resampling techniques for assessing uncertainty, and are more accurate in practise than classical methods. In deed, the results in table (5a) and (5b) show that there is a slight amelioration in all the regression coefficients, but in fact this is not sufficient to give different outcomes. Therefore, it is not a problem of data sample size that we are facing but rather the quality of the data which is the most important caveat.

7. Conclusions and Policy recommendations

In this paper, we examined empirically the causality issue between money and prices for a sample covering the Maghreb countries namely Algeria, Morocco and Tunisia and different periods ranging from 1975 to 2003.
First, we have tested the order of integration of the variables. For Morocco and Tunisia we are unable to reject the null hypothesis that the variables M1, M2 and CPI are an I(1). For Algeria, However the I(1) hypothesis is rejected for the period 1975-2003 (i.e., when annual data was used). In fact, the series were found to be I(2). But When the hypothesis was tested for the post reform period only (i.e. 1990-2003 quarterly data), the results show that we are unable to reject the hypothesis that M1, M2 and CPI are I(1) series. Second, The Cointe gration Regression Durbin Watson (CRDW) gives conflicting results in the three cases.

As far as the first regression is concerned, The results show that this test is not significantly different from zero suggesting rejection of cointegration in the case of Algeria in the first period (1975-2003) and even when using the post reform period (1990-2003), whereas when the second regression is tested, the results show that the I(0) hypothesis is rejected only for the case of Algeria when the whole period is taken. Third, The ADF statistic tests show that the residuals of the regressions are found to be stationary I(0) in the case of Morocco and Tunisia. Thus the money supply (M1 or M2) and the price level (CPI) these countries are cointegrated. The ADF results for Algeria, however do not support the I(0) hypothesis when using the whole period (i.e., 1975-2003). In fact, the results show that neither M1 nor M2 are cointegrated with the price level. On the other hand, when using the post reform period for Algeria, the results show that if we could not accept the cointegration hypothesis between M1 and the price level, the relationship between M2 and CPI is found to be cointegrated.

The results for the Algerian case, mainly when the whole period is used, do not tend to support the quantity theorist's view that money and prices have a long-run relationship, i.e., they do not tend to drift apart in the long run. However, as suggested by Granger (1986) money and prices could still cointegrate if other variables, which may have influenced prices, were included in the cointegration regressions. As far this research is concerned we have included the Gross Domestic Product (GDP) in the cointegration regression. Indeed, the results show that there is a long-run equilibrium relationship between Money and the price level.

As far as the Granger causality tests are concerned, the results for both Morocco and Tunisia show that the causation is from money (i.e., M1) to prices without significant feedback. This tends to support the quantity theorist's view that the causal relation between money and prices is from the former to the latter. Further, it supports Darrat's (1986) findings that money causes prices in Morocco and Tunisia. Thus the monetary authorities in these two countries can consider control of the money supply (M1) to influence and control inflation. As suggested by monetarists, this can be best achieved by maintaining a steady rate of growth of the money supply, roughly corresponding to the long-run growth of the real output. For Algeria, however the results show no causation between money (M1) and prices, i.e., the two variables are independent. One possible explanation of this is that the data for the Consumer Price Index (CPI) are not reliable mainly at the period preceding the economic reforms.. This might be true given that the prices which are reported by the authorities are always lower than those paid by the people.

The causality tests are also made between M2 and CPI. For Algeria, the results reveal different outcomes. Where if we are still rejecting the causality hypothesis between money and prices in the first period, the results show when using the post reform data, M2 and the price level are cointegrated with significant feedback. Surprisingly, for the case of Morocco and Tunisia conflicting results are found. There is no causation between M2 and the price level in Morocco, and we could only accept this hypothesis at the 10 % confidence level for the case of Tunisia. So how could we use M2 as the Tunisian and Moroccan Central Bank's leading indicator of monetary policy? However , given the weakness of the data, and because the period we have used in our tests covers some years preceding economic reforms, it is recommended to use empirical findings for future policy design with caution. Due to the above problem, we have used bootstrap methods, but in fact this was not sufficient to give different outcomes.

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Appendices

Table (1): Statistics for ADF Unit Root Tests

		Level		First Difference		Second Difference	
		Lag	**t-ADF**	**Lag**	**t-ADF**	**Lag**	**t-ADF**
Algeria (1975-2003)	CPI	1	-2,35	1	-1,32	1	3,92*
	M1	1	-2,33	1	-2,6	1	-4,94**
	M2	3	-1,11	3	-3,23	3	-3,01*
	PIB	1	-2,26	1	-2,86	1	-4,52**
Algeria (1990:01-2003:04)	CPI	1	-0,98	1	-7,96**		
	M1	1	-2,08	1	-5,25**		
	M2	5	-0,67	5	-8,28**		
Tunisia (1987:03-2003:04)	CPI	1	-0,92	1	-8,08**		
	M1	1	-2,04	1	-7,38**		
	M2	1	-2,84	1	-9,89**		
Morroco (1975-2003)	CPI	3	0,58	3	-2,29*		
	M1	1	-0,97	1	-5,77**		
	M2	2	-3,06	2	-4,02*		

*Notes: Variables are defined in the text. For each variable expressed in level (first difference), the Augmented Dickey Fuller (1979) (ADF) statistics test the null hypothesis of a unit root in that variable expressed in level (first difference) against an alternative of a stationary root. The criterion for lag selection is based on the Akaike information criterion. *, **, denote rejection at 5 percent and 1 percent respectively*

Table 2a- Cointegration Regressions and tests for Cointegration.

$$Cointegration\ Regression: LCPI_t = b_0 + b_1 LM1_t + u_t$$

	$_0$	$_1$	t $_1$	R^2	CRDW	ADF_1	ADF_2
Algeria (1975-2003)	-10.33	1.10	17.64	93.68%	0.28	-1.48	-1.74
Algeria (1990-2003)	0.69	0.39	14.39	81.83%	0.25	-2.15	
Morocco	0.99	0.29	10.49	83.99%	2.35	-8.41	
Tunisia	0.93	0.40	4.12	22.41%	1.55	-4.77	

* The null hypothesis is that u_t and v_t is I(1).

The dependent variable is the logarithm of the price level. t $_1$ and t $_1$ are the t-statistics of $_1$ and $_1$, respectively.

R2 is the coefficient of determination. CRDW is equal to Durbin Watson Statistic.

Appropriate critical values for ADF Statistic at the 5% level is -3.48, with the rejection region (ADF/ADF

Table 2b- Cointegration Regressions and tests for Cointegration.

Cointegration Regression : $LCPI_t = b_0 + b_1 LM2_t + v_t$							
	0	1	t 1	R^2	CRDW	ADF_1	ADF_2
Algeria (1975-2003)	-8.37	0.90	18.30	94.36%	0.44	-1.60	-2.87
Algeria (1990-2003)	-6.89	0.92	19.87	89.56%	1.10	-4.55	
Morocco	-0.42	0.40	17.94	93.87%	1.36	-8.41	
Tunisia	1.43	0.31	3.59	17.93%	1.46	-4.54	

Table 2c- Cointegration regression (When including the GDP variable)

Cointegration Regression : $LCPI_t = b_0 + b_1 LM1_t + b_2 GDP_t + u_t$

	0	1	2	t 1	T 2	R^2	CRDW	ADF
Algeria (1975-2003)	-6.65	-0.10	0.86	-0.69	7.92	98.47%	1.66	-2.32

Appropriate critical values for ADF Statistic at the 5% level is -1.95, with the rejection region (ADF/ADF -1.95).

Table 2d- Cointegration regression (When including the GDP variable)

Cointegration Regression : $LCPI_t = b_0 + b_1 LM2_t + b_2 GDP_t + v_t$

	0	1	2	t 1	T 2	R^2	CRDW	ADF
Algeria (1975-2003)	-6.84	-0.10	0.88	-0.67	6.68	98.31%	1.70	-2.24

Appropriate critical values for ADF Statistic at the 5% level is -1.95, with the rejection region (ADF/ADF -1.95).

Table 3b Johansen cointegration test (CPI , M2)

Country	Eigenvalue	L,R, ratio	5% critical value	1% critical value	H0(n° of CE(s))
Algeria (1975-2003)	0,368 0,231	14.47 5.27	25,32 12,25	30,45 16,26	None At most 1*
Algeria (1990-2003)	0,358 0,142	27.52 7.09	25.32 12.25	30.45 16.26	None* At most 1
Morroco	0.65 0,11	22.39 2.32	15.41 3.76	20.04 6.65	None* At most 1
Tunisia	0.409 0,128	37.93 7.86	25.32 12.25	30.45 16.26	None* At most1

* denotes rejection of the hypothesis at 5% significance level.

Table 4a: Granger causality test (CPI , M1)

Country	*null hypothesis*	*F-statistic*	*probability*
Algeria (1975-	(m1) does not Granger cause (cpi) (cpi) does not Granger cause (m1)	1,65 2,49	0,222 0,11
Algeria (1990-2003)	(m1) does not Granger cause (cpi) (cpi) does not Granger cause (m1)	0,102 0,67	0,75 0,41
Morocco	(m1) does not Granger cause (cpi) (cpi) does not Granger cause (m1)	4,21 0,82	0,03 0,45
Tunisia	(m1) does not Granger cause (cpi) (cpi) does not Granger cause (m1)	5,49 2,66	0,02 0,1

Table 4b: Granger causality test (CPI , M2)

Country	*null hypothesis*	*F-statistic*	*probability*
Algeria (1975-2003)	(m2) does not Granger cause (cpi) (cpi) does not Granger cause (m2)	0.79 0.62	0.467 0.551
Algeria (1990-2003)	(m2) does not Granger cause (cpi) (cpi) does not Granger cause (m2)	4.66 4.38	0.004 0.005
Morocco	(m2) does not Granger cause (cpi) (cpi) does not Granger cause (m2)	0.73 0.61	0,49 0.55
Tunisia	(m2) does not Granger cause (cpi) (cpi) does not Granger cause (m2)	3.09 0.19	0.08 0.66

Table (5a): Bootstrap Results (: $LCPI_t = \beta_0 + \beta_1 LM1_t + u_t$)

Country	original Results			bootstrap		
	1	R^2	t- 1	1	R^2	t- 1
Algeria (1975-2003)	0,9	0,9436	18,3	0,91	0,9727	14,91
Algeria (1990-2003)	0,92	0,8956	19,87	0,93	0,9473	17,54
Morroco	0,406	0,9387	17,94	0,408	0,9719	11,33
Tunisia	0,315	0,1793	3,59	0,318	0,4285	2,65

Notes: Bootstrap method takes into consideration econometric problems faced by the original results. Such problems could be due the small sample size, and non homogeneity of the data.

Table (5b): Bootstrap Results (: $LCPI_t = \beta_0 + \beta_1 LM2_t + u_t$)

Country	original Results			Bootstrap		
	1	R^2	t- 1	1	R^2	t- 1
Algeria (1975-2003)	1.01	0,9368	17.64	1.15	0,9688	14,37
Algeria (1990-2003)	0.39	0,8183	14.39	0.399	0,9021	19.95
Morroco	0,29	0,8399	10.49	0,31	0,9377	4.76
Tunisia	0,4	0,2241	4.12	0,38	0,4712	3.16

Notes: Bootstrap method takes into consideration econometric problems faced by the original results. Such problems could be due the small sample size, and non homogeneity of the data.